UNIT 3 Basic Differentiation **NAME:**___________________________

REVIEW

DATE:_______

Evaluate the limit.

1. $\lim_{x\to\infty} \frac{x^3+5x^2-x}{1-e^x} =$

2. $\lim_{x\to 2} \frac{x^2+7x-18}{x^2-2x} =$

Given $f(x)$ on a given interval $[a, b]$, find a value c that satisfies the Mean Value Theorem.

3. $f(x) = -x^2 + 4x - 2;\ \ [-1, 2]$

Find b and c so that $f(x)$ is differentiable at $x = 1$.

4. $f(x) = \begin{cases} 3x^2 + 4x, & x \le 1 \\ 2x^3 + bx + c, & x > 1 \end{cases}$

Find the derivative of the following.

5. $f(x) = \frac{\sin x}{x^2+1}$

6. $g(x) = \sqrt{2x^3 - 4x}$

7. $y = \frac{x^3+4x-1}{2x}$

8. $h(x) = \cos^2(4x)$

Find the following

9. $f(x) = x^2 \sin(x)$

$f'\left(\frac{\pi}{2}\right) =$

10. $g(x) = \frac{1}{\sqrt{x}}$

$g''(x) =$

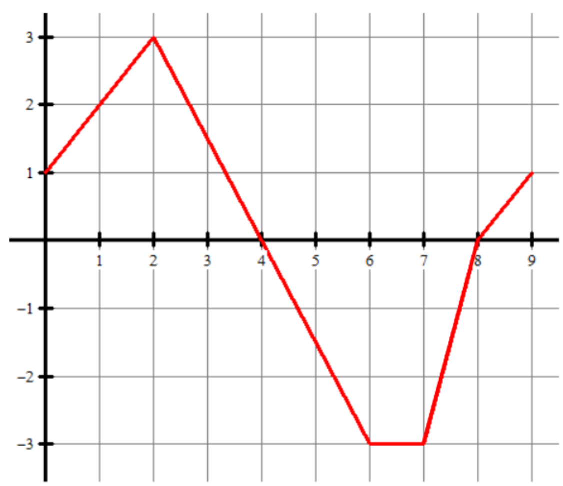
Write the equation of the tangent line and the normal line at the point given.

11. $f(x) = 3\tan x$ at $x = \pi$

Particle Motion

12. The position of a particle moving along a coordinate line is $s(t) = 2t^3 - 6t$, with *s* in meters and *t* in seconds. Find the particle's velocity and acceleration at $t = 6$.

13. The figure shows the velocity $v = \frac{ds}{dt} = f(t)$ of a body moving along a coordinate line in meters per second.



a) When does the body reverse direction?

b) When is the body moving at a constant speed?

c) What is the body's maximum speed?

d) At what time interval(s) is the body slowing down?

Use the information to find the following.

14. The table shows the number of stores of a popular US coffee chain from 2000 to 2006. The number of stores recorded is the number at the start of each year, on January 1st.

***t* (year)**	2000	2001	2002	2004	2005	2006
***S* (stores)**	1996	2729	3501	5239	6177	7353

Approximate the instantaneous rate of change in coffee stores per year at the beginning of 2003.

You are allowed to use a graphing calculator for #15

15. The amount $A(t)$ of pain reliever in milligrams in a patient's system after t minutes is given by $A(t) = 8te^{-t/50}$.

a. Find $A(60)$. Explain what it means in a sentence.

b. Find $A'(60)$. Explain what it means in a sentence.

c. Find $A(t) = 100$. Explain what it means in a sentence.

d. What is the average rate of change of milligrams from 60 minutes to 180 minutes?

e. What is the instantaneous rate of change at 180 minutes?

f. When does $A'(t) = 0$? What is happening at this point?

g. Find $\lim_{t\to\infty} A(t)$. Explain what it means in a sentence.

TEST PREP

1. A particle is traveling along the x-axis. Its position is given by $x(t) = \frac{1-t^2}{t+3}$ at time $t \geq 0$. Find the instantaneous rate of change of x with respect to t when $t = 1$.

(A) -2
(B) $-\frac{1}{2}$
(C) 0
(D) $\frac{1}{2}$
(E) 2

2. The line $2x - y = 9$ is tangent to the curve $f(x)$ at the point $(4, -1)$. What is the value of $'(4)$?

(A) -2
(B) $\frac{1}{2}$
(C) 2
(D) 4
(E) 9

3. If $f(x) = e^x$, which of the following is equal to $f'(e)$?

(A) $\lim\limits_{h \to 0} \frac{e^{x+h}}{h}$

(B) $\lim\limits_{h \to 0} \frac{e^{x+h} - e^e}{h}$

(C) $\lim\limits_{h \to 0} \frac{e^{e+h} - e}{h}$

(D) $\lim\limits_{h \to 0} \frac{e^{e+h} - 1}{h}$

(E) $\lim\limits_{h \to 0} \frac{e^{e+h} - e^e}{h}$

4. The graph of $f(x)$ is shown below. What is the value of $f(1) + f'(1) + 2f'(4)$?

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4